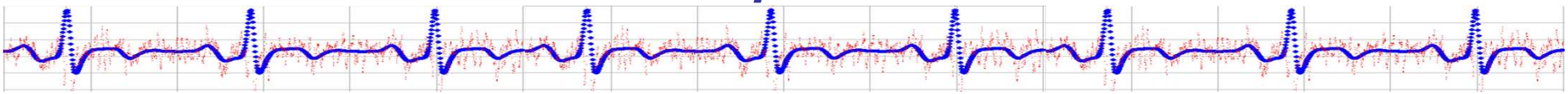
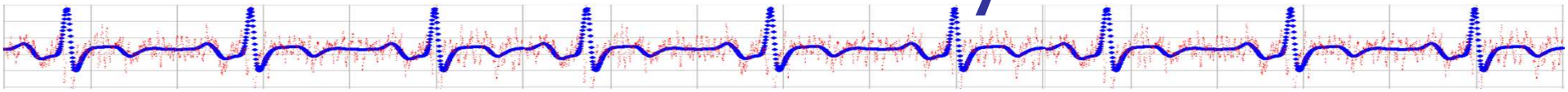
Empirical Research Methods in Information Science

IS4800 / CS6350



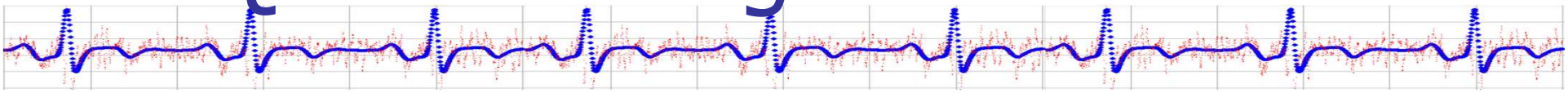
Lecture 5:
Research Designs

Overview for today



- Quick reading assessment
- Ethnography homework
- Research designs
- Python (briefly)
- Homework I2b
- Back to human subjects research (maybe)

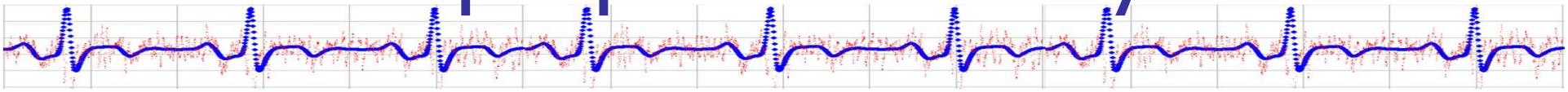
Quick reading assessment



Closed book, closed computer

10 minutes

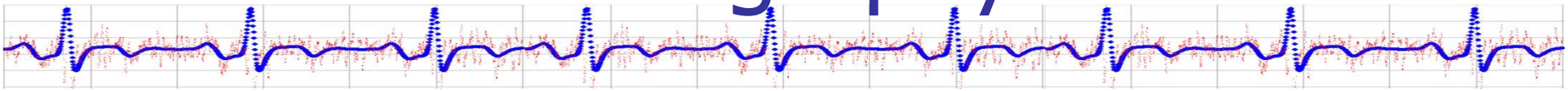
Class prep for Monday



- Reading: Objective measures (B&A Ch 5). Descriptive statistics (B&A Ch 13 to 421)
- Python tutorial (to be emailed)

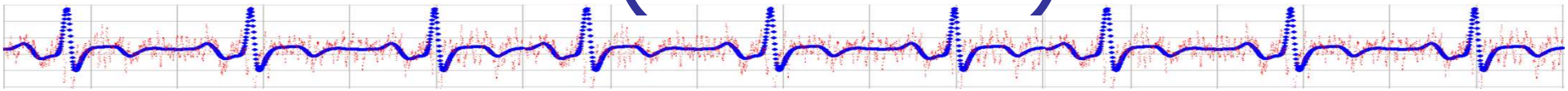
- Be working on Assignment I2!

Finish ethnography homework



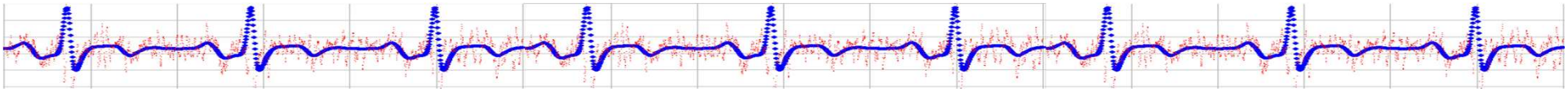
- Goal: idea to make the common area of ISEC more efficient and friendly
  - Pick a location and spend an hour people watching with a notebook and pencil. **Put away ALL devices**.
  - Identify an activity you find interesting.
  - Watch several people do it. Get bored watching. Then start to see the hidden patterns.
  - Interview one or two about it.
- Suggestions for classmates?
- Questions?

Start I2b (due Wed)

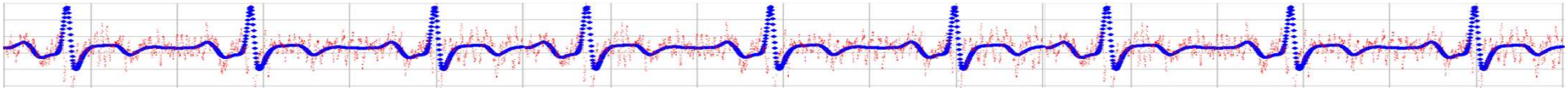


- Identify two measurable variables from your ethnographic study that might conceivably be associated
- Design separate descriptive, correlational and experimental research designs for studying these variables
- For each, include a diagram (such as the one in Figure 6 from the sample research plan, but with just one or two boxes) and text describing the purpose of the study, the measures you plan to use, and what the results would be useful for
- Identify a possible "third variable" that might invalidate predictions made with results from the correlational study and how this will be controlled in the experimental study

Research models

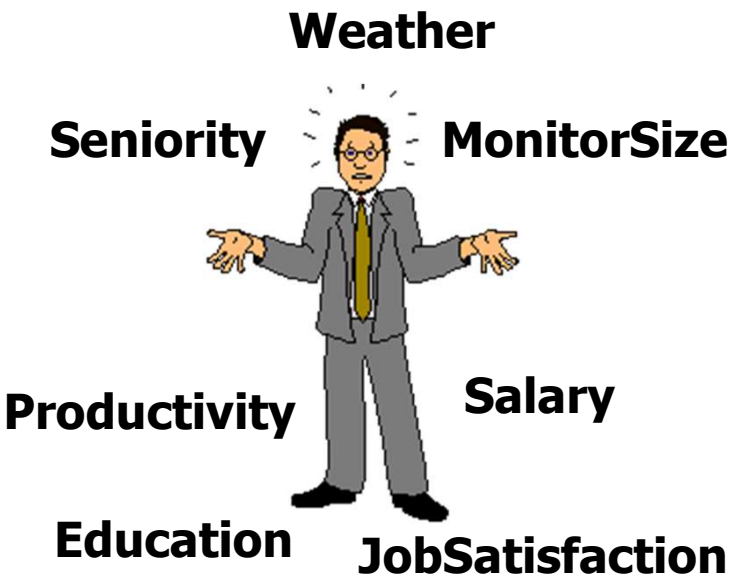


Quantitative, empirical research



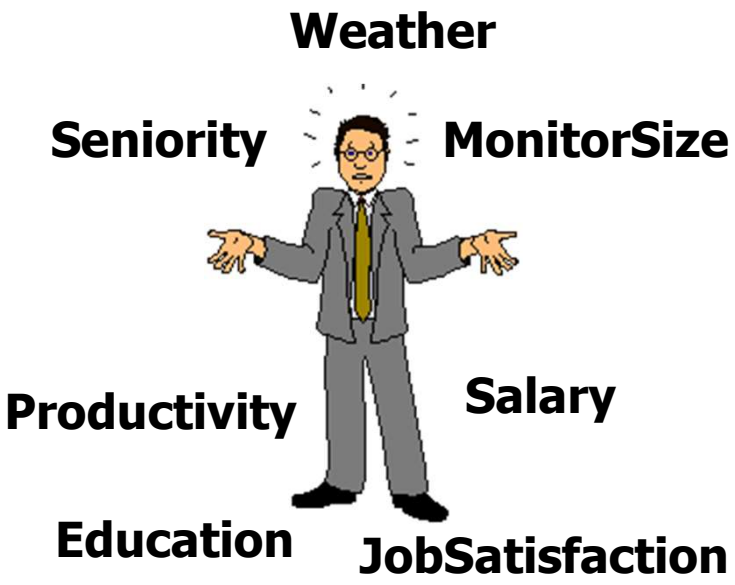
Basic assumptions

- The world can be decomposed into variables
- Variables
  - Can be observed and measured
  - Can have numeric or categorical values
  - Until proven otherwise, they are assumed to vary randomly



Variables

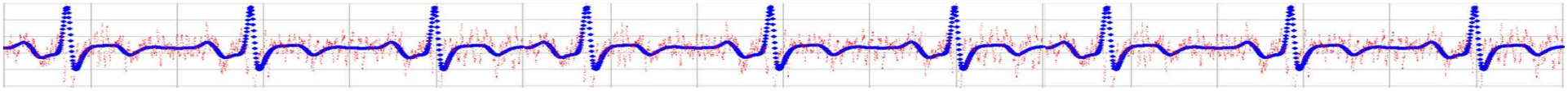
If we assume that all variables are independent, and we do not manipulate them… what kind of study can we do?



Descriptive

aka "Exploratory Data Collection"

Observation vs. intervention

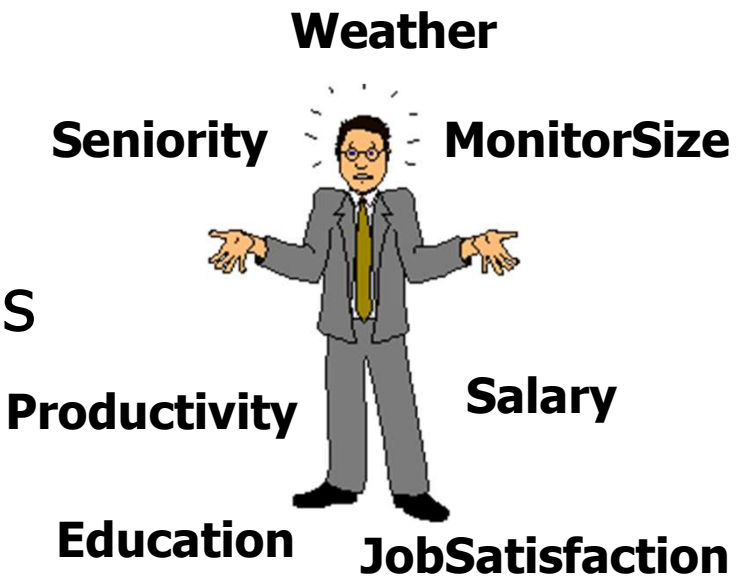


- Observation:
  Passive recording and measurement

- Intervention (aka "manipulation"):
  Actively *changing* the world to see what happens

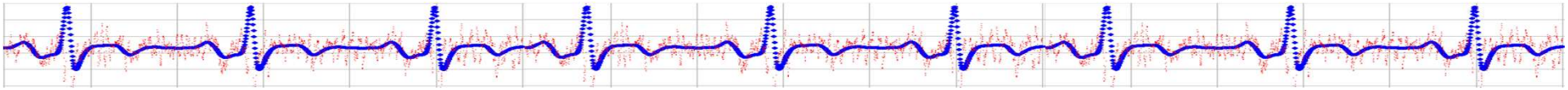
Intervening on the world…

- If you can manipulate some part of the world that impacts everyone…
- And measure variables *afterwards*…
- What kind of study can you do?

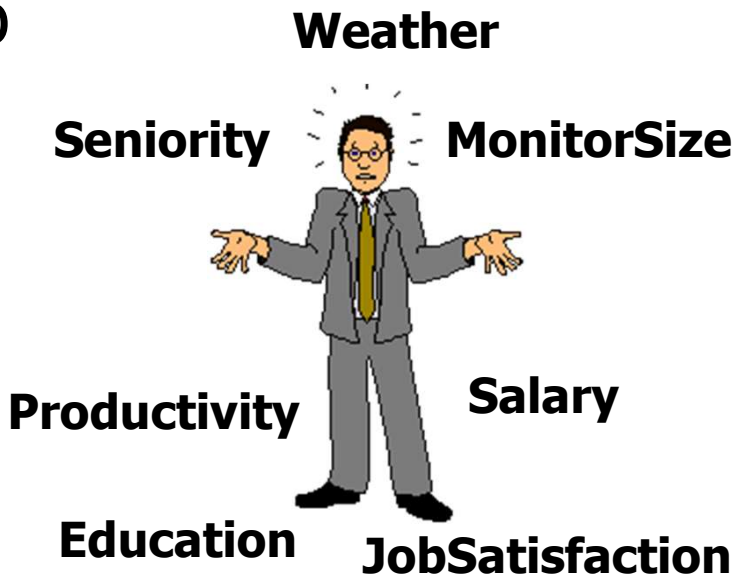


Demonstration

Associations between Variables



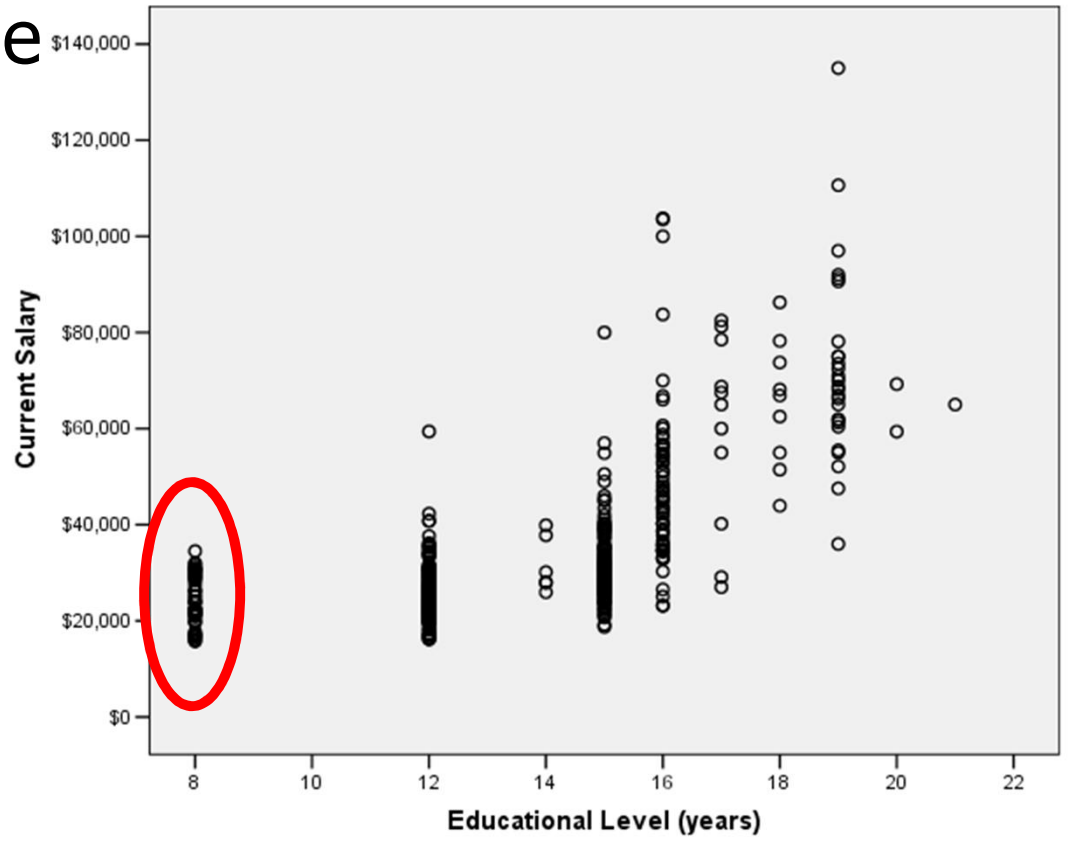
- You notice that some pairs of variables seem to change together in systematic ways…
- And, you're just observing…
- What kind of study can you do?



Correlational

Correlational study

- How to characterize the association between two variables?
- e.g. Salary & Education Level?

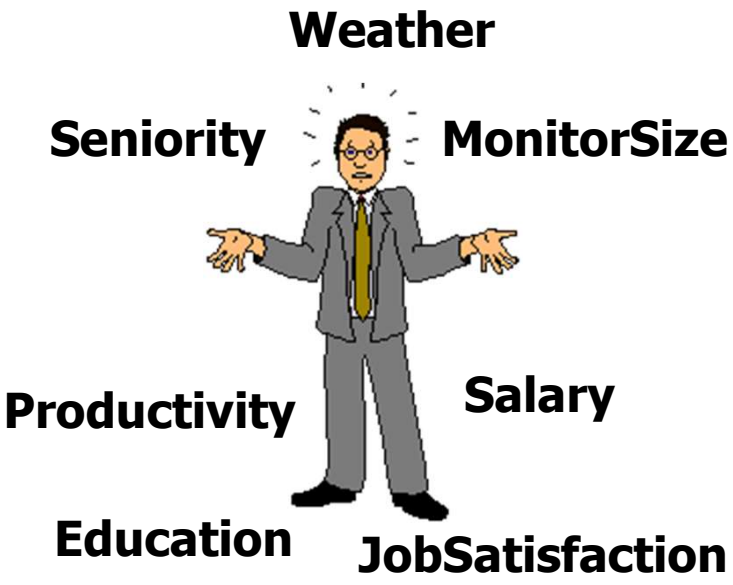


Causality between variables

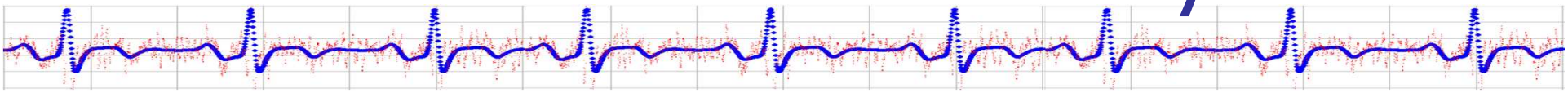
After observing two variables covarying, you hypothesize that there is a causal link between them…

MonitorSize ⟶	Productivity
14”	15 wpd*
17”	20 wpd
21”	21 wpd

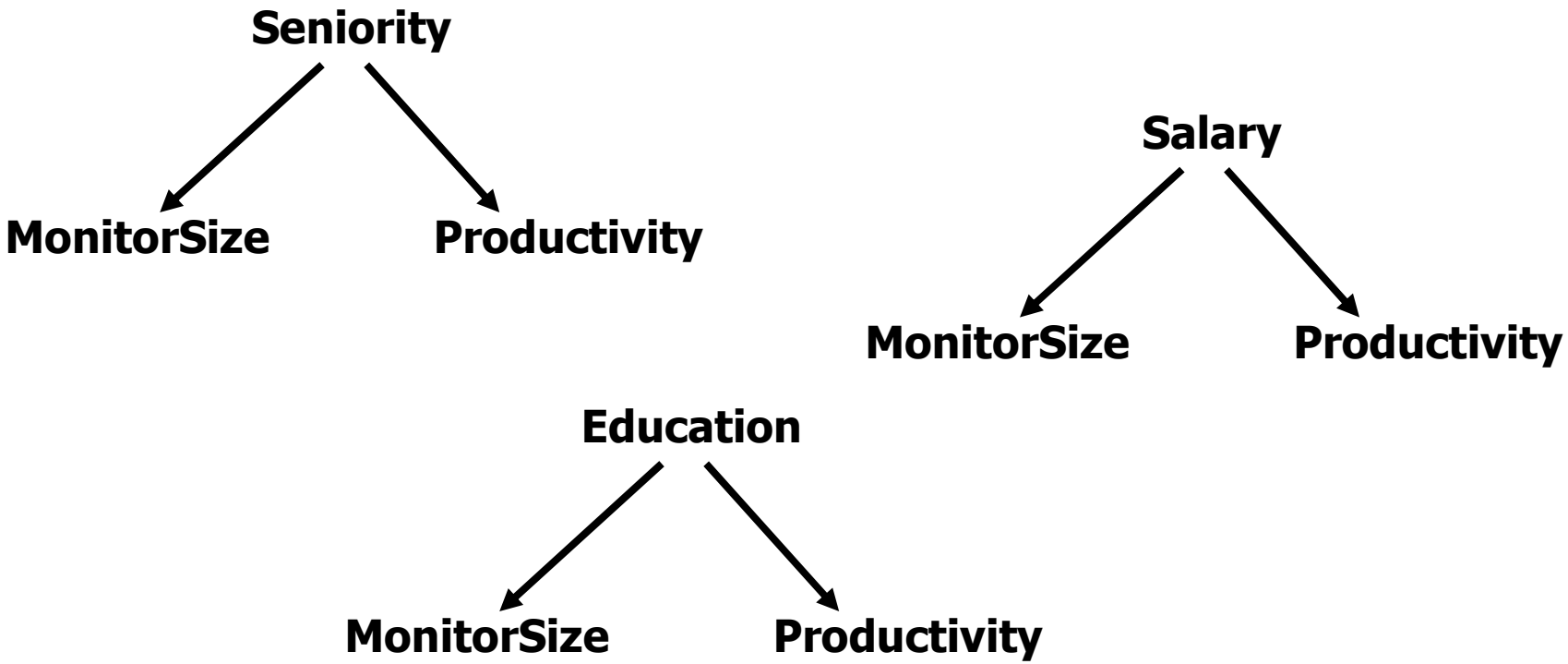
*widgets/day



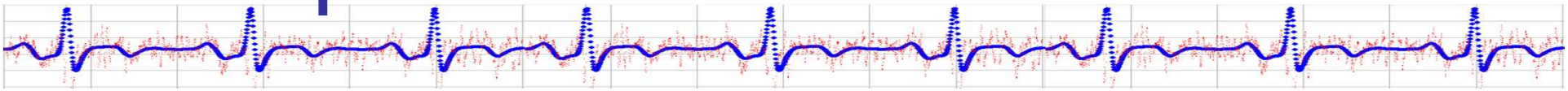
Fundamental difference: association vs. causality



Other explanations?

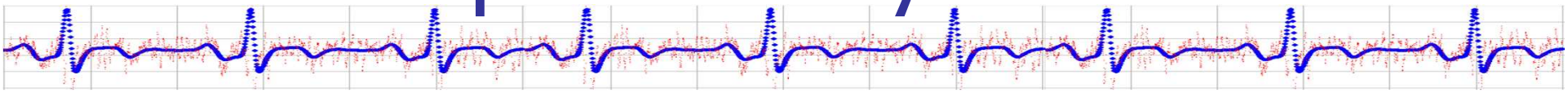


Experiments



- Isolate IV as the ONLY difference between treatment groups
  - Rules out possible "3rd variables"
- How?
  - Hold extraneous variables constant, OR
  - Randomize subjects between treatments

Sample research model: Descriptive study



- Aka "exploratory data collection"
- Example: Characterize salaries, job satisfaction, and education level for the company

Salary

JobSatisfaction

Education

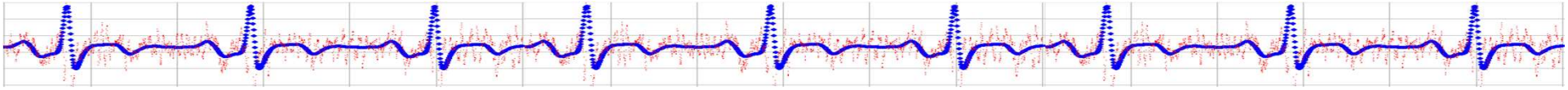
Or, more conveniently …

Salary
JobSatisfaction
Education

Example descriptive study

For the "ECAs to Promote Health Literacy…" – what's an example of a descriptive study?

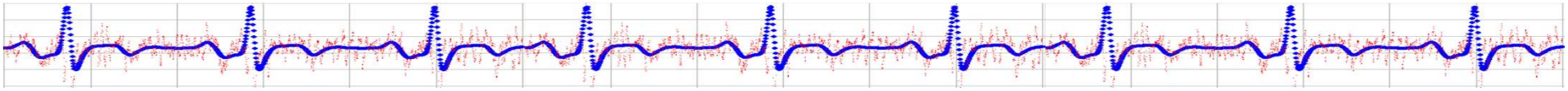
Sample research model: Demonstration



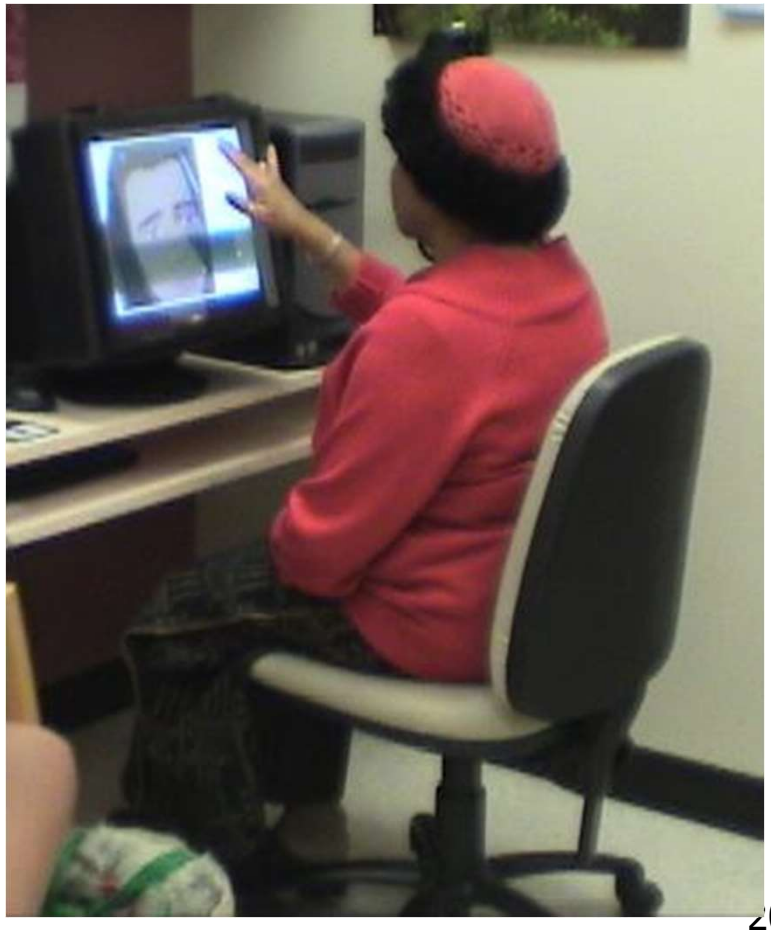
Example: Characterize JobSatisfaction and Productivity after introducing 36” monitors for all engineers

MonitorSize
JobSatisfaction
Productivity

Demonstrations

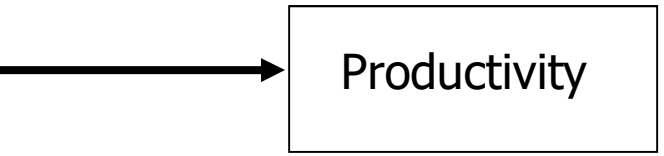


For the "ECAs to Promote Health Literacy…" – what's an example of a demonstration?



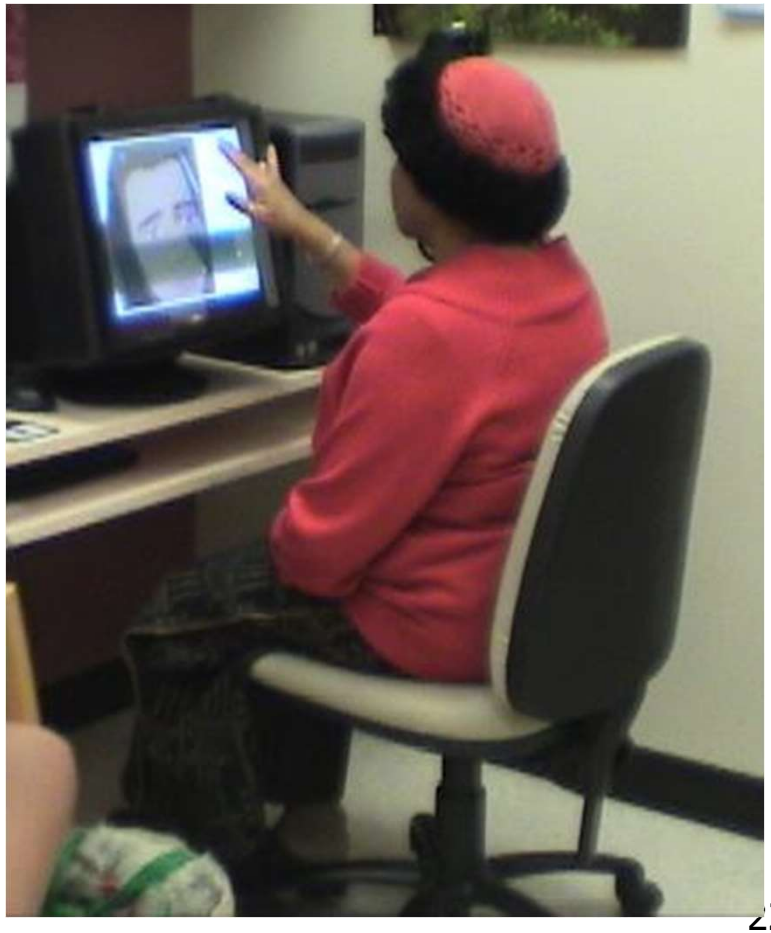
Sample research model: Correlational study

Example: Characterize the relationship between Productivity and MonitorSize for all engineers

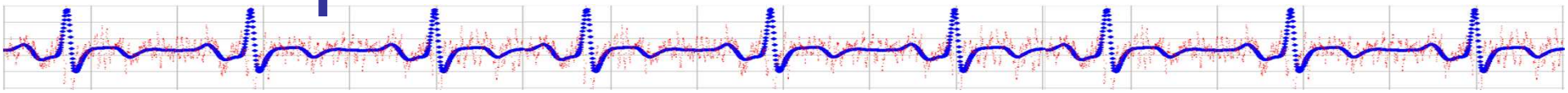


Correlational Studies

For the "ECAs to Promote Health Literacy…" – what's an example of a correlational study?



Experimental studies

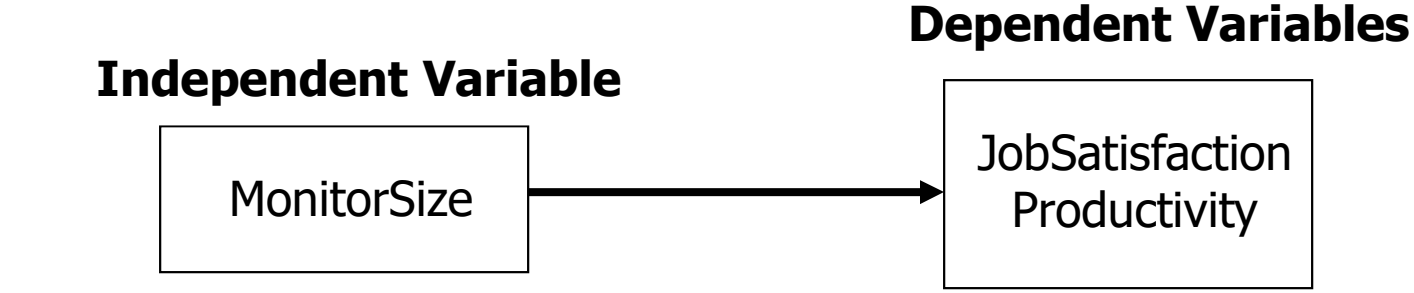


- Defining characteristics
  - Manipulation of a variable ("independent variable")
  - Comparison between two or more conditions
  - Control of extraneous variables

- Measured variable is "dependent" or "outcome" variable
- Values of IV = "treatments" or "conditions" or "arms"

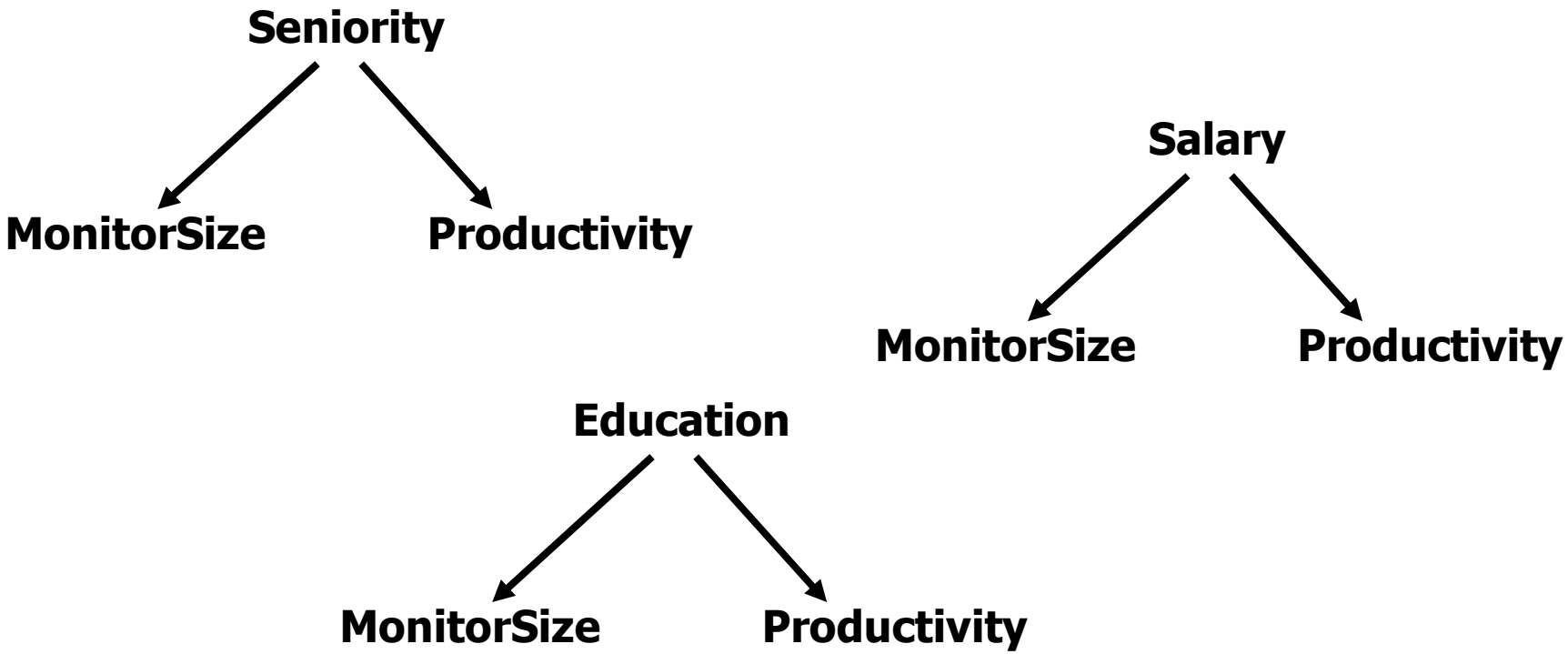
Sample research model: Experimental study

Determine the effect of increasing MonitorSize on JobSatisfaction and Productivity



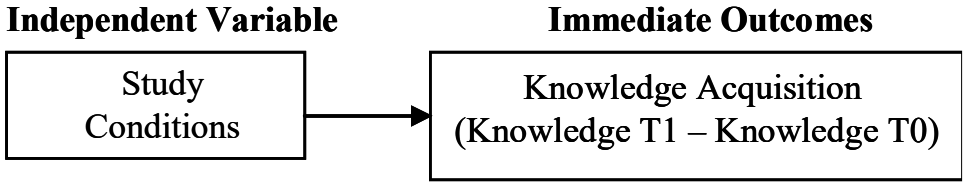
Sample research model: Experimental study

How can we eliminate these alternatives?

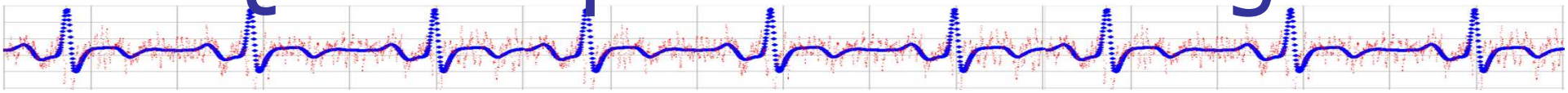


Sample research model: Experimental study

For the "ECAs to Promote Health Literacy…" – what's an example of an experimental study?



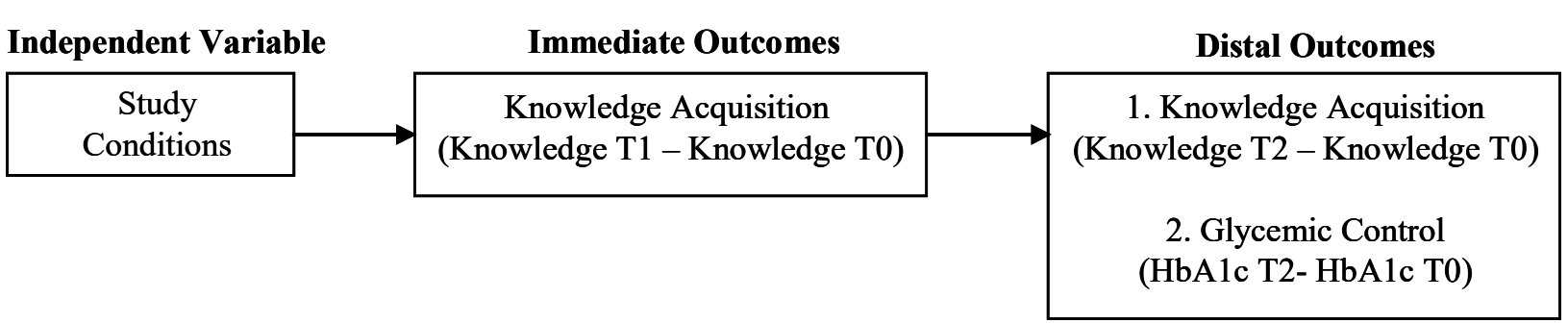
Quasi-experimental designs



- Correlational or experimental?
- Use "quasi-independent variables"
  - E.g., naturally-occurring event
  - Little or no control over variable
- If researcher does not control group membership of conditions (no randomization), not a true experiment

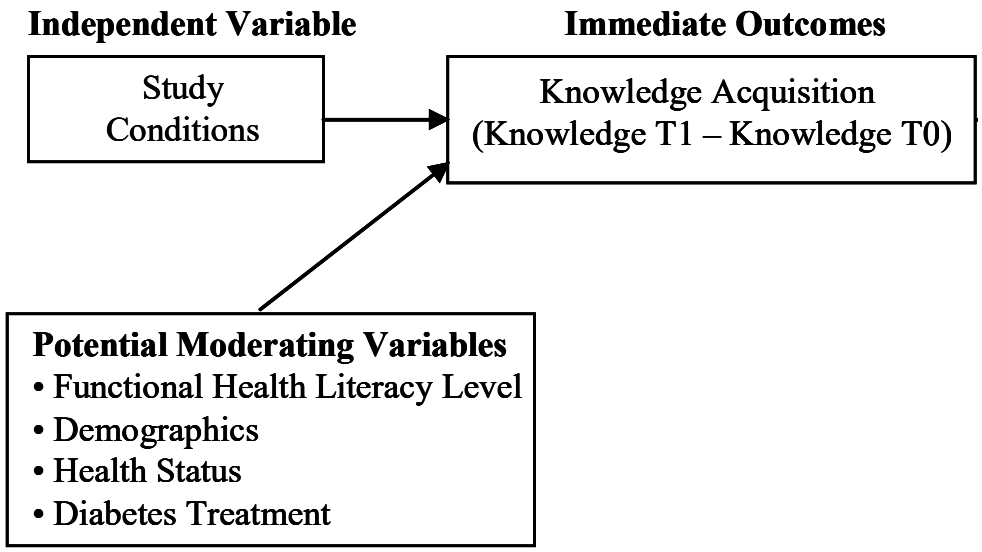
Mediating variables

- Affect some variables and are affected by other variables
- Change during the course of intervention, are correlated with the intervention, and have an effect on outcomes

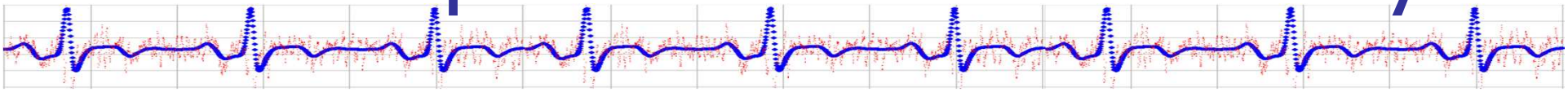


Moderating variables

- Baseline variables that are uncorrelated with intervention and define subgroups that may respond differentially to intervention
- Modifies the relationship between IV & DV

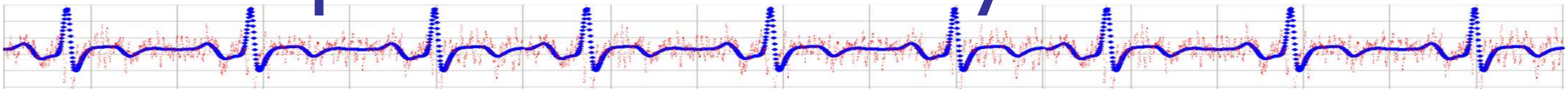


Example: What kind of study?



- Newspaper headline: “Heavy Drinkers Get Lower College Grades”

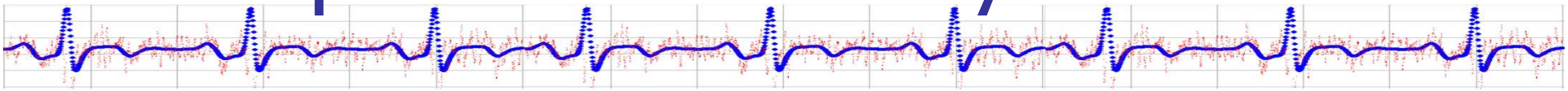
Example: Could this be an experimental study?



- Newspaper headline: "People remember concrete words better than abstract ones"

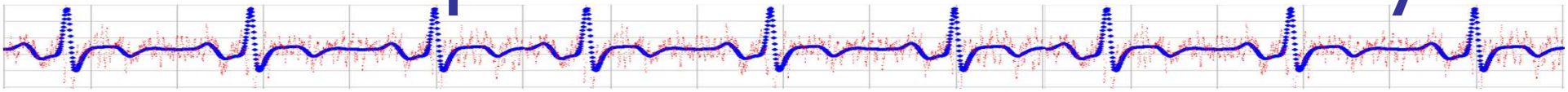
- How might you study it?

Example: Could this be an experimental study?



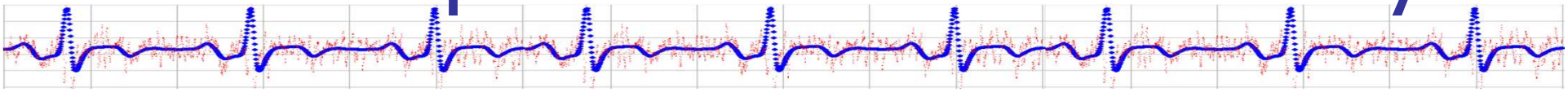
- A private school advertises that a group of their students recently scored 10 points higher on a math test than a group of other students from a public school
- Quasi-experiment: Two groups are compared, but researcher did not control group membership; interpret as a correlational study

Example: What kind of study?



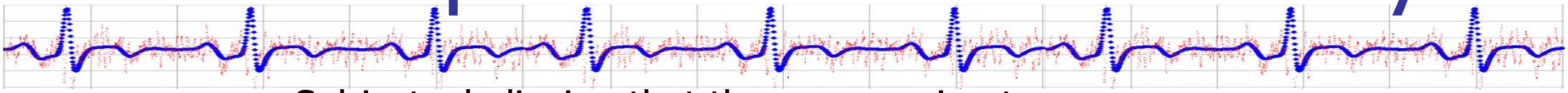
- Researchers found that average temperatures were much higher in years when more people wore t-shirts, shorts, bikinis and other garments that expose lots of skin to direct sunlight.
- "These data show the important linkage between world climate change and the deterioration of the moral fiber of our society," said Melvin Ebbles, professor of sociometeorology at the University of Alberta and leader of the research team.
- "One of the first steps in arresting global warming must be to rein in the growing tendency towards public exhibitionism of the human body."
- Professor Ebbles suggested that risqué garments allow the skin to release more carbon dioxide and other greenhouse gases into the atmosphere. Greenhouse gases prevent solar energy from escaping into outer space, effectively transforming the earth into an enormous pressure cooker.
- Professor Ebbles suggested that the United States should take steps to encourage its citizens to dress more modestly. "After all," he said, "hardly anyone wears bikinis up here in Canada and its always very cold."

Example: What kind of study?



- DirectPill, the orientation-improving drug that has improved the ability of rats to follow directions, also works for men, Italian researchers reported.
- "Our results demonstrate that DirectPill may directly improve male direction following," Professor Salvatore Carosso said in a report in the British Journal of Wayfinding.
- In the first study on the use of DirectPill on men with poor wayfinding skills, Caruso and his colleagues tested the pills on 51 men ages 22 to 38.
- The men were randomly selected to receive DirectPill in 25-mg. or 50-mg. doses or a placebo over three four-week periods, with a week's interruption between each. Each month, the men rated their directional acuity and feelings of directional loss on a five-point scale. The scientists said directional acuity scores of the men taking DirectPill rose from 1.5 to 4.2 on both drug doses. But the placebo group achieved only a 2.6 grade. Feelings of directional loss all declined in the DirectPill group.

Example: What kind of study?



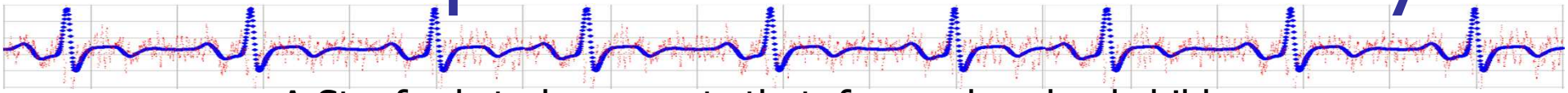
- Subjects, believing that they were going to complete a personality inventory, were seated in a chemistry classroom facing a large cabinet.
- There were three signs posted on the cabinet saying: "DANGER," "KEEP OUT," and "Attention: Cabinet Contains Hazardous Chemicals Intended ONLY for Animal Research. Possible Harm to Humans if Exposed!!! DO NOT OPEN." Inside the cabinet was a sealed brown box.
- After one minute, an "authority figure" entered the room. The authority figure was dressed in a police uniform.
- The authority figure said to the subject: "I am late for a meeting with your dean. I want you to get in that cabinet and take the box to the president's office immediately."
- Results showed that 13 of 17 subjects obeyed the authority figure, despite the signs posted on the cabinet.

Example: What kind of study?

- Raising the price of beer leads to a reduction in cases of gonorrhoea, researchers have said.
- The research from the US suggests that raising the price of a six-pack of beer by 20 cents would cut gonorrhoea rates by almost 9%.
- Researchers at the Centers for Disease Control and Prevention looked at gonorrhoea rates between 1981 and 1995 among teenagers and young adults in US states that raised the legal drinking age or increased the state beer tax.
- Dr Kathleen Irwin, at the centre's Division of Sexually Transmitted Diseases Prevention, said: "Of the 36 beer tax increases that we reviewed, gonorrhoea rates declined among teens aged 15 to 19 in 24 instances.

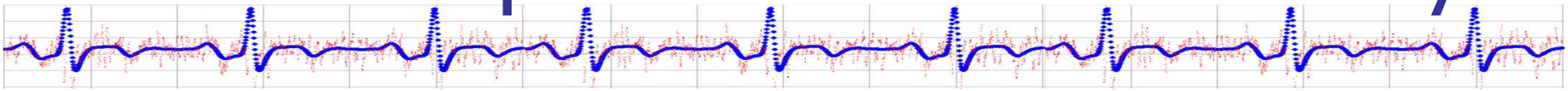
A spokeswoman for Brook sexual health advisory centres said: "Making a direct link like this is probably quite dangerous and simplistic.
"The important thing is providing sexual information and advice, rather than raising the price of beer."

Example: What kind of study?

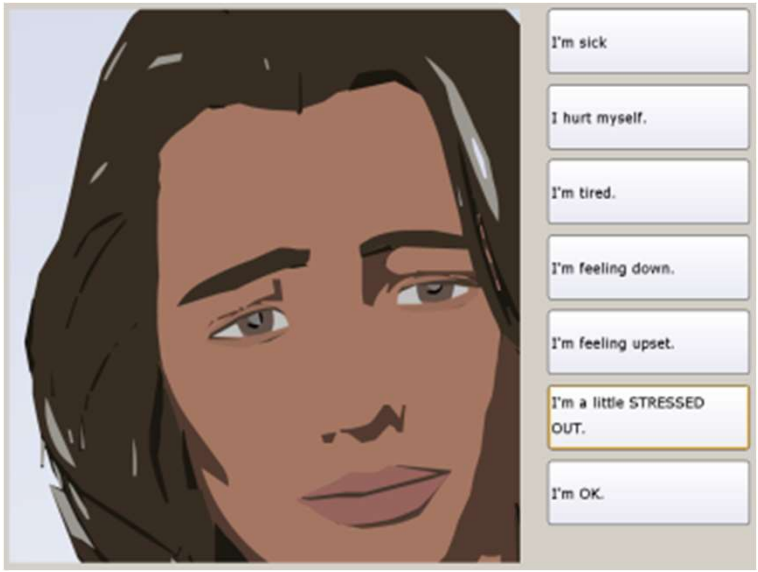


- A Stanford study suggests that, for grade-school children, watching less television may be a key to limiting weight gain. Children who were involved in a one-year curriculum to reduce their TV viewing gained significantly less body fat than a control group of their peers.
- Local education officials picked two schools with similar ethnic composition, socioeconomic standing and scholastic achievement.
- At one of the schools, the third- and fourth-graders received an 18-lesson program, presented by their classroom teachers as part of the normal school curriculum, that was designed to reduce TV and videotape watching and video game playing.
- Both schools agreed to participate before learning which school would receive the curriculum, and the students at each school were found to have similar TV viewing habits and body fatness at the beginning of the school year, Robinson said.

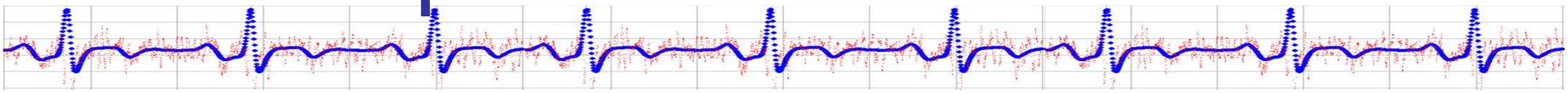
Example: what kind of study?



- 30 day intervention to get young adults with schizophrenia to take their antipsychotics as prescribed.
- Intervening on several behaviors in parallel:
  - System use
  - Medication adherence
  - Physical activity
- 20 subjects, all use intervention



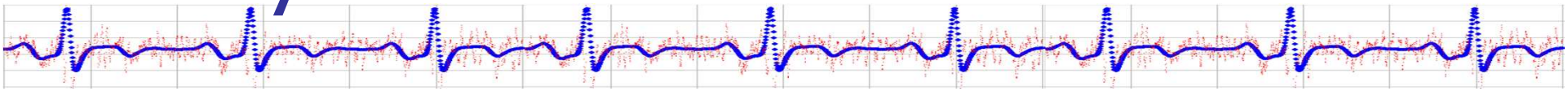
Group exercise



Want to study efficiency of WizziWord software in BigBucks, Inc.

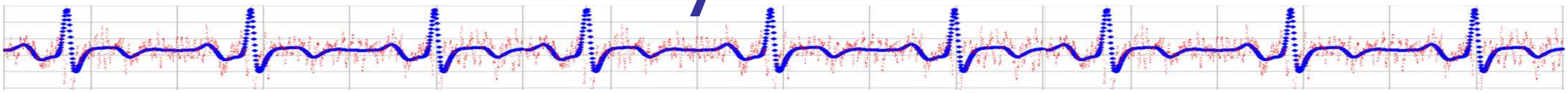
1. Design a descriptive study
2. Design a demonstration study
3. Design a correlational study
4. Design an experimental study

Python



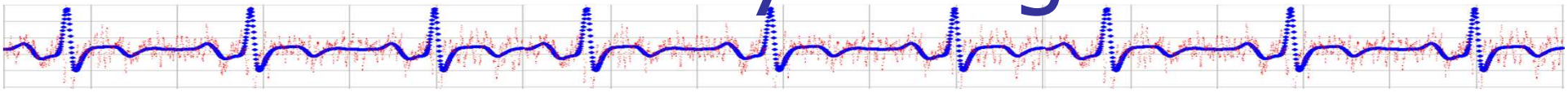
- General purpose programming language particularly good for working with data
- Features:
  - Full programming language
  - For many tasks, more flexible than R
  - Relatively easy to learn basic concepts
  - Good open-source packages for many data management/computation tasks, including graphing, computing descriptive statistics, and statistical analysis
  - Free to use (as opposed to software such as SPSS, SAS, Matlab)
  - Extensible
- Many common statistical techniques have been implemented

Your first Python mission



- Read the tutorial
- Download the software on your computer
- Create (or load) some dummy data
- Create a bar chart
- Ask questions on Piazza when you get stuck

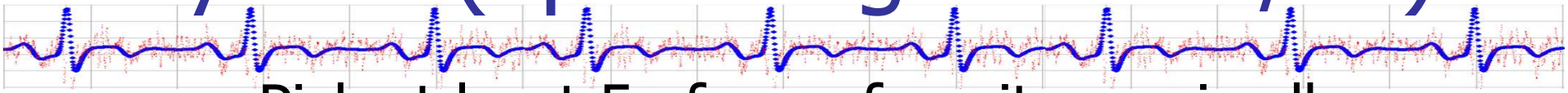
Short term Python goal



By 1/30 you will need to be fluent enough in Python to:

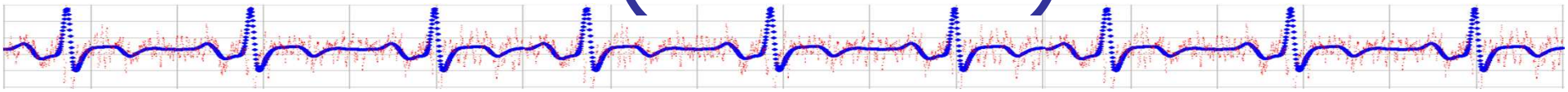
- Load data from a csv file
  (You can export a csv file from Excel)
- Compute a variety of descriptive statistics
- Create a variety of visualizations
- Export so you can put graphs in a report

Python (optional goal for 1/30)



1. Pick at least 5 of your favorite music albums. Create an Excel spreadsheet with the following columns: Album, Tracks, Cost, PctCost. Fill in the data.
2. Save a copy to csv format and import to Python.
3. Create a bar chart showing the number of tracks per album.
4. Create a pie chart showing PctCost labeled by Album.
5. Paste the charts into a report (e.g., Word document)

Start I2b (due Wed)



- Finish ethnographic study.
- Identify two measurable variables from your ethnographic study that might conceivably be associated
- Design separate descriptive, correlational and experimental research designs for studying these variables
- For each, include a diagram (such as the one in Figure 6 from the sample research plan, but with just one or two boxes) and text describing the purpose of the study, the measures you plan to use, and what the results would be useful for.
- Identify a possible "third variable" that might invalidate predictions made with results from the correlational study and how this will be controlled in the experimental study.